



## **NASA STTR 2007 Phase I Solicitation**

### **T9 Rocket Propulsion Testing Systems**

In support of NASA's plans and visions for current space activities and future exploration goals, ground and simulated altitude testing of all large rocket propulsion systems are conducted at the John C. Stennis Space Center (SSC). Current testing includes the Space Shuttle Main Engine and the Rocketdyne RS68 engine. Existing test facilities are being modified and a new test stand is being built to test the Rocketdyne J-2X engine for the Constellation program.

This topic solicits advanced technologies: that support an Integrated Health Management (ISHM) capability for rocket engine testing and ground operations; for innovative non-intrusive sensors for measuring combustion instability, fluid properties under extreme conditions of pressure, temperature, and velocity; rocket plume sensors capable of measuring gas species, temperature, and velocity for hydrogen and hydrocarbon fuels. Specifically, sensors capable of measuring hot gas velocity up to Mach 5 in a vacuum and the heat flux impinging on the inside surface of a pipe during altitude simulation are needed to support J-2X engine testing. Computational tools to accurately model and predict rocket engine test stand components and system performance are also desired.

## **Subtopics**

### **T9.01 Rocket Propulsion Testing Systems**

**Lead Center: SSC**

**Center: SSC**

Proposals are sought for innovative technologies in the area of propulsion test operations. Proposals should support the reduction of overall propulsion test operations costs (recurring costs) and/or increase reliability and performance of propulsion ground test facilities and operations methodologies. Specific areas of interest in this subtopic include the following:

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## **Facility and Test Article Health-Monitoring Technologies**

Innovative, non-intrusive sensors for measuring gas velocity, temperature, pressure, molecular and metallic plume constituents, and environmentally sensitive effluent gas detection. Low-millisecond to sub-millisecond response time is required. Temperature sensors must be able to measure cryogenic temperatures of fluids (as low as 160R for LOX and 34R for LH<sub>2</sub>) under high pressure (up to 15,000 psi), high flow rate conditions (2000 lb/s 82 ft/s for LOX; 500 lb/s 300 ft/s for LH<sub>2</sub>). Flow rate sensors must have a range of up to 2000 lb/s (82 ft/sec) for LOX and 500 lb/sec (300 ft/s) for LH<sub>2</sub>. Pressure sensors must have a range up to 15,000 psi. Rocket plume sensors should be capable of measuring gas species, temperature, and velocity for H<sub>2</sub>, O<sub>2</sub>, hydrocarbon and hybrid fuels.

Rugged, high accuracy (0.2%), fast response, temperature measuring sensors and instrumentation for very high pressure, high flow rate cryogenic piping systems. Temperature sensors must be able to measure cryogenic temperatures of fluids (as low as 160R for LOX and 34R for LH<sub>2</sub>) under high pressure (up to 15,000 psi), high flow rate conditions (2000 lb/s 82 ft/s for LOX; 500 lb/s 300 ft/s for LH<sub>2</sub>). Response times must be on the order of a few milliseconds to sub-milliseconds.

Modeling, sensors, and instrumentation for prediction, characterization, and measurement of rocket engine combustion instability. Sensor systems should have bandwidth capabilities in excess of 100 kHz. Emphasis is on development of non-intrusive optical-based sensors.

## **Test Facility Modeling Tools and Methods**

Developing and verifying test facilities is complex and expensive. The wide range of pressures, flow rates, and temperatures necessary for engine testing result in complex relationships and dynamics. It is not realistic to physically test each component and the component-to-component interaction in all states before designing a system. Currently, systems must be tuned after fabrication, requiring extensive testing and verification.

Tools using computational methods to accurately model and predict system performance are required that integrate simple interfaces with detailed design and/or analysis software. SSC is interested in improving capabilities and methods to accurately predict and model the transient fluid structure interaction between cryogenic fluids and immersed components to predict the dynamic loads, frequency response of facilities.

Component Design, Prediction and Modeling - Improved capabilities to predict and model the behavior of components (valves, check valves, chokes etc.) during the facility design process. This capability is required for

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modeling components in high pressure 12,000 psi, high flow 100 lb/sec cryogenic environments and must address two-phase flows.

Process System Design, Prediction and Modeling - Improved capabilities to predict and model process systems. The capability should incorporate the previous two areas to accurately model the process systems and test articles.

## **T9.02 Field Sensors, Instruments, and Related Technologies**

**Lead Center: SSC**

**Center: SSC**

Coastal environments and their natural resources are vital to our Nation's economy, security, commerce and recreation. These environments are strongly impacted by severe weather and other natural hazards. Because most of the world's population lives in coastal regions, these important and dynamic environments are also significantly impacted by human-induced events. Moreover, they are also especially sensitive to the initial effects of global climate change.

This subtopic solicits innovative field measurement technologies and analytical tools to support NASA's remote sensing technologies used in coastal research and applications. Specific interests at SSC include the following:

- Coupling of land and ocean processes (run-off, air quality, material flux);
- Coral reef mapping and health;
- Algal blooms (detection and monitoring);
- Sea level rise (measuring and forecasting effects);
- Sediment and contaminant transport (measuring and monitoring);
- Natural disasters such as tropical systems, tsunamis, and floods (planning, impact assessment, mitigation,

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and recovery).